EE3221 Homework 1 Dr. Prust Assigned: 23 March 2020 Due: 27 March 2020 (1:00PM CDT)

Note: Problems from the course textbook (Ulaby and Yagle, 2018) are specified with the prefix "UY".

- 1. UY 6.62
- 2. UY 6.66

Hints: You should find that the impulses in $X_s(\omega)$ cancel one another out! Therefore, the output of the reconstruction filter will be zero.

- 3. Consider the continuous-time signal $x(t) = \sin(t)/t$.
 - (a) Find its Fourier transform $X(\omega)$.
 - (b) Make an accurate sketch of $|X(\omega)|$. Is the signal bandlimited?
 - (c) Determine the the minimum sampling frequency required for sampling x(t) without aliasing.
 - (d) Determine the sampling interval T_s so that sampling x(t) results in $x_s(0) = 1$ and all other sample values $x(nT_s) = 0$ for $n \neq 0$.

ANSWERS:

- (a) $X(\omega) = \pi [u(\omega + 1) u(\omega 1)]$
- (b) $X(\omega)$ is bandlimited
- (c) Must choose sample frequency $\omega_s > 2$.
- (d) Choosing $T_s = \pi$ will produce the stated result.
- 4. Consider the signal $x(t) = \cos(2000\pi t) + \sin(6000\pi t) + \cos(12000\pi t)$.
 - (a) What is the Nyquist sampling rate for x(t)?
 - (b) Assume x(t) is sampled at $f_s = 5000$ Hz using impulse-train sampling. Plot the spectrum of the sampled signal $x_s(t)$ assuming impulse-train sampling.
 - (c) Assume the sampled signal $x_s(t)$ is passed through the ideal reconstruction filter based on f_s . What frequencies are present in the reconstructed signal $x_r(t)$?

ANSWERS: Nyquist sampling rate is 12kHz. 1kHz and 2kHz are present in $x_r(t)$.

5. UY 6.71

ANSWERS: All three signals have Nyquist sampling rate 20π rad/s.